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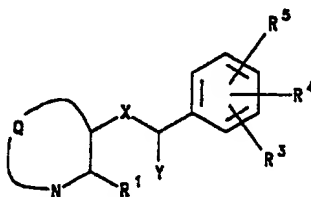
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EP 0499313 A WO 93/04040 A WO 91/18899 A

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(54) Azabicyclic tachykinin-receptor antagonists

(57) Compounds of formula (I), and salts and prodrugs thereof:



(I)

wherein

Q is the residue of an optionally substituted azabicyclic ring system (preferably quinuclidine);

X represents O, S, CH₂ or CH;

Y represents H, OH, =O or halo;

R¹ represents phenyl optionally substituted by halo or trifluoromethyl; and

R³, R⁴ and R⁵ independently represent H, C₁₋₆ alkyl, C₂₋₆ alkenyl, C₂₋₆ alkynyl, halo, cyano, nitro, trifluoromethyl, trimethylsilyl, -OR^a, SCH₃, SOCH₃, SO₂CH₃, -NR^aR^b, -NR^aCOR^b, -NR^aCO₂R^b, -CO₂R^a or -CONR^aR^b

(where R^a and R^b independently represent H, C₁₋₆ alkyl, phenyl or trifluoromethyl);

with the proviso that when X is O or S, Y is H; are tachykinin receptor antagonists useful in therapy.

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THERAPEUTIC AGENTS

This invention relates to a class of
5 azabicyclic compounds, which are useful as tachykinin
antagonists. More particularly, the compounds of the
invention comprise an azabicyclic ring system substituted
by an arylmethoxy or arylmethylthio moiety and by a
phenyl moiety.

10 The tachykinins are a group of naturally-
occurring peptides found widely distributed throughout
mammalian tissues, both within the central nervous system
and in the peripheral nervous and circulatory systems.
The structures of three known mammalian tachykinins are
15 as follows:

Substance P:

Arg-Pro-Lys-Pro-Gln-Gln-Phe-Phe-Gly-Leu-Met-NH₂

Neurokinin A:

His-Lys-Thr-Asp-Ser-Phe-Val-Gly-Leu-Met-NH₂

20 Neurokinin B:

Asp-Met-His-Asp-Phe-Phe-Val-Gly-Leu-Met-NH₂

For example, substance P is believed inter alia
to be involved in the neurotransmission of pain
sensations. [Otsuka et al, "Role of Substance P as a
25 Sensory Transmitter in Spinal Cord and Sympathetic
Ganglia" in 1982 Substance P in the Nervous System, Ciba
Foundation Symposium 91, 13-34 (published by Pitman) and
Otsuka and Yanagisawa, "Does Substance P Act as a Pain
Transmitter?" TIPS (Dec. 1987) 8 506-510], specifically
30 in the transmission of pain in migraine (B.E.B. Sandberg
et al, J. Med Chem, (1982) 25 1009) and in arthritis
[Levine et al in Science (1984) 226 547-549]. These
peptides have also been implicated in gastrointestinal
(GI) disorders and diseases of the GI tract such as

inflammatory bowel disease [Mantyh et al in Neuroscience (1988) 25 (3) 817-37 and D. Regoli in "Trends in Cluster Headache" Ed. Sicuteri et al, Elsevier Scientific Publishers, Amsterdam (1987) page 85)]. It is also
5 hypothesised that there is a neurogenic mechanism for arthritis in which substance P may play a role [Kidd et al "A Neurogenic Mechanism for Symmetrical Arthritis" in The Lancet, 11 November 1989 and Grönblad et al
10 "Neuropeptides in Synovium of Patients with Rheumatoid Arthritis and Osteoarthritis" in J. Rheumatol. (1988) 15(12) 1807-10]. Therefore, substance P is believed to be involved in the inflammatory response in diseases such as rheumatoid arthritis and osteoarthritis [O'Byrne et al in Arthritis and Rheumatism (1990) 33 1023-8]. Other
15 disease areas where tachykinin antagonists are believed to be useful are allergic conditions [Hamelet et al Can. J. Pharmacol. Physiol. (1988) 66 1361-7], immunoregulation [Lotz et al Science (1988) 241 1218-21 and Kimball et al, J. Immunol. (1988) 141 (10) 3564-9]
20 vasodilation, bronchospasm, reflex or neuronal control of the viscera [Mantyh et al, PNAS (1988) 85 3235-9] and, possibly by arresting or slowing β -amyloid-mediated neurodegenerative changes [Yankner et al, Science (1990) 250, 279-82] in senile dementia of the Alzheimer type,
25 Alzheimer's disease and Down's Syndrome.

Substance P may also play a role in demyelinating diseases such as multiple sclerosis and amyotrophic lateral sclerosis [J. Luber-Narod et al, poster to be presented at C.I.N.P. XVIIIth Congress, 28th
30 June-2nd July 1992, in press], and in disorders of bladder function such as bladder detrusor hyper-reflexia [Lancet, 16th May, 1992, 1239].

It has furthermore been suggested that tachykinins have utility in the following disorders:

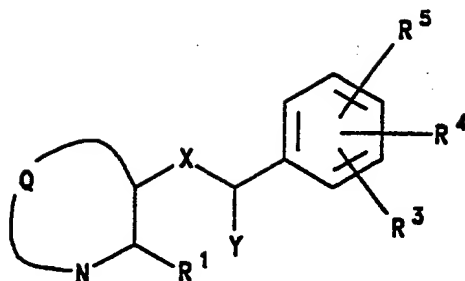
depression, dysthymic disorders, chronic obstructive
airways disease, hypersensitivity disorders such as
poison ivy, vasospastic diseases such as angina and
Reynauld's disease, fibrosing and collagen diseases such
5 as scleroderma and eosinophilic fasciitis, reflex
sympathetic dystrophy such as shoulder/hand syndrome,
addiction disorders such as alcoholism, stress related
somatic disorders, neuropathy, neuralgia, disorders
related to immune enhancement or suppression such as
10 systemic lupus erythematosus (European patent application
no. 0 436 334), ophthalmic disease such as conjunctivitis,
vernal conjunctivitis, and the like, and cutaneous
diseases such as contact dermatitis, atopic dermatitis,
urticaria, and other eczematoid dermatitis (European
15 patent application no. 0 394 989).

In view of their metabolic instability, peptide
derivatives are likely to be of limited utility as
therapeutic agents. It is for this reason that non-
peptide tachykinin antagonists are sought.

20 WO-A-90/05729 describes inter alia a class of
cis-3-[cyclic]methylamino-2-[(α -substituted)-
arylmethyl]quinuclidine compounds which are stated to be
useful as substance P antagonists for treating
gastrointestinal disorders, central nervous system
25 disorders, inflammatory diseases and pain or migraine.
There is, however, no disclosure or suggestion in WO-A-
90/05729 of the arylmethoxy- or arylmethylthio-
substituted azabicyclic derivatives provided by the
present invention.

30 We have now found a further class of non-
peptides which are potent antagonists of tachykinin.

The present invention provides a compound of
formula (I), or a salt or prodrug thereof:



(I)

wherein

Q is the residue of an optionally substituted azabicyclic ring system;

X represents O, S, CH₂ or CH;

15 Y represents H, OH, =O or halo;

R¹ represents phenyl optionally substituted by halo or trifluoromethyl;

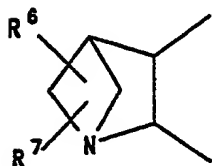
20 R³, R⁴ and R⁵ independently represent H, C₁-6 alkyl, C₂-6 alkenyl, C₂-6 alkynyl, halo, cyano, nitro, trifluoromethyl, trimethylsilyl, -OR^a, SCH₃, SOCH₃, SO₂CH₃, -NR^aR^b, -NR^aCOR^b, -NR^aCO₂R^b, -CO₂R^a or -CONR^aR^b; and

R^a and R^b independently represent H, C₁-6 alkyl, phenyl or trifluoromethyl;

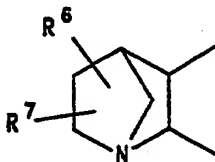
25 with the proviso that when X is O or S, Y is H.

30 The azabicyclic ring system of which Q is the residue is a non-aromatic ring system containing, as the sole heteroatom, the nitrogen atom indicated in formula (I) above. Suitably the ring system contains from 6 to 10 ring atoms, preferably from 7 to 9 ring atoms. The azabicyclic ring system may be fused, spiro or bridged, preferably bridged. The azabicyclic ring system may be substituted by one or more groups selected from carbonyl, C₁-4alkyl, C₂-4alkenyl, C₂-4alkynyl, halo, hydroxy,

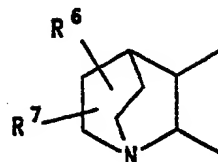
C₁₋₄alkoxy, carboxy or C₂₋₄alkoxycarbonyl. Examples of such azabicyclic ring systems include:



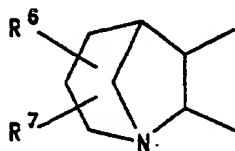
(A)



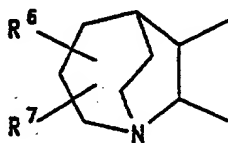
(B)



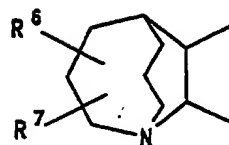
(C)



(D)



(E)



(F)

wherein

R⁶ and R⁷ independently represent H, C₁₋₄ alkyl, C₂₋₄ alkenyl, C₂₋₄ alkynyl, halo, hydroxy, C₁₋₄ alkoxy, carboxy or C₂₋₄ alkoxycarbonyl; or R⁶ and R⁷ together represent carbonyl.

It will be appreciated that the nitrogen atom in the azabicyclic ring system will carry a lone pair of electrons.

It will also be appreciated that the R⁶ and R⁷ substituents may be present at any position in the azabicyclic ring system, including, where appropriate, the bridgehead carbon atom depicted in structures A to F above.

Suitably the group R⁶ is H or methyl; and R⁷ is H, C₁₋₄ alkyl, hydroxy or C₁₋₄ alkoxy, preferably H, methyl, hydroxy or methoxy. Preferably one or more preferably both of R⁶ and R⁷ is/are H.

Suitably the azabicyclic ring system of which Q is the residue is a 1-azabicyclo[2.2.1]heptanyl (1-azanorbornanyl), 1-azabicyclo[2.2.2]octanyl (quinuclidinyl) or 1-azabicyclo[3.2.1]octanyl ring system of formula B, C or D above, respectively, any of which is optionally substituted by methyl or hydroxy. A preferred ring system is quinuclidine of formula C above.

It will be appreciated that when X represents CH, there is a carbon-carbon double bond between X and the carbon atom of the azabicyclic ring system to which it is attached.

The alkyl, alkenyl and alkynyl groups referred to with respect to any of the formulae herein may represent straight, branched or cyclic groups. Thus, for example, suitable alkyl groups include methyl, ethyl, n- or iso-propyl, n-, sec-, iso- or tert-butyl, cyclopropyl, cyclobutyl, cyclopentyl or cyclohexyl, and cycloalkyl-alkyl groups such as cyclopropylmethyl; suitable alkenyl groups include vinyl and allyl; and suitable alkynyl groups include propargyl.

The term "halo" as used herein includes fluoro, chloro, bromo and iodo.

In one preferred group of compounds according to the invention, X is O.

In a further preferred group of compounds of formula (I), X is CH. When X is CH or CH₂, Y is preferably OH or halo, especially fluoro.

Preferably R¹ represents unsubstituted phenyl.

Suitably, R³, R⁴ and R⁵ independently represent H, C₁₋₆ alkyl, C₂₋₆ alkenyl, C₂₋₆ alkynyl, halo, cyano, nitro, trifluoromethyl, -OR^a, -NR^aR^b, -NR^aCOR^b, -NR^aCO₂R^b, -CO₂R^a or -CONR^aR^b; and

R^a and R^b independently represent H or C₁₋₆ alkyl.

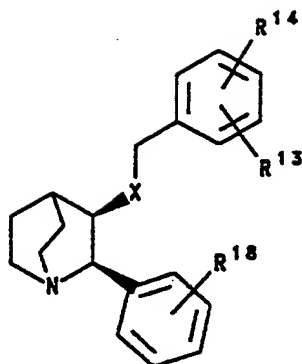
For example, suitable values for the groups R³, R⁴ and R⁵ include H, amino, nitro, trifluoromethyl, trimethylsilyl, halo, cyano, methyl, ethyl, cyclopropyl, vinyl, carbonylmethoxy, methoxy and phenoxy, more
5 suitably H, nitro, trifluoromethyl and halo, such as chloro.

Preferably, at least one of R³, R⁴ and R⁵ is other than H. More preferably, two of R³, R⁴ and R⁵ are other than H. The (non-H) substituents are preferably at
10 the 3- and 5-positions of the phenyl ring. In a particularly preferred group of compounds of formula (I), two of R³, R⁴ and R⁵ are trifluoromethyl and the other is H.

The compounds according to the invention have
15 at least two asymmetric centres, and may accordingly exist both as enantiomers and as diastereoisomers. In particular, the relative orientation of the substituents on the azabicyclic ring system in formula (I) above may give rise to cis and trans diastereoisomers. It is to be
20 understood that all such isomers and mixtures thereof are encompassed within the scope of the present invention.

It is believed that of the cis diastereomers, tachykinin receptor antagonist activity preferentially resides in the 2S,3S diastereomer, whereas of the trans
25 diastereomers, activity preferentially resides in the 2R,3S diastereomers. Thus, it is believed that S stereochemistry at the 3-position of the azabicyclic is crucial to tachykinin receptor antagonist activity.

A particular sub-class of compounds according
30 to the invention is represented by the compounds of formula IIA, and salts and prodrugs thereof:



(IIA)

wherein

X represents O or S, preferably O;

R¹³ and R¹⁴ independently represent H,

15 C₁-6alkyl, C₂-6alkenyl, halo, cyano, nitro,
-CO₂(C₁-6alkyl), trifluoromethyl, trimethylsilyl,
hydroxy, C₁-6 alkoxy, phenoxy or amino; and

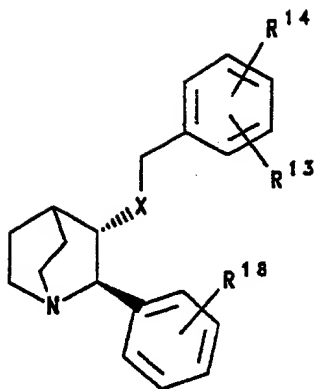
R¹⁸ represents H, halo or trifluoromethyl.

Particular values of R¹³ and R¹⁴ include H,

20 C₁-5alkyl, especially methyl, ethyl and cyclopropyl,
C₂-6alkenyl, especially vinyl, halo, nitro,
trifluoromethyl, trimethylsilyl, cyano, methoxy and
phenoxy. Preferably, R¹³ and R¹⁴ are selected from
hydrogen, nitro, trifluoromethyl and halo, especially
25 chloro. Preferably, at least one of R¹³ and R¹⁴ is other
than H. More preferably, R¹³ and R¹⁴ are both other than
H and are located at the 3- and 5-positions of the phenyl
ring.

Preferably, R¹⁸ represents H.

30 A second sub-class of compounds according to
the invention is represented by the compounds of formula
(IIB), and salts and prodrugs thereof:



(IIB)

wherein X, R¹³, R¹⁴ and R¹⁸ are as defined for formula (IIA) above.

15 Suitably, in formula (IIB) X represents O or S, preferably O;

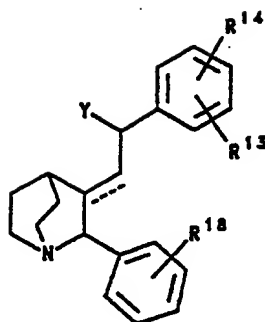
R¹³ and R¹⁴ independently represent phenoxy or, preferably, H, C₁₋₆ alkyl, halo, cyano, nitro, trifluoromethyl, hydroxy, C₁₋₆ alkoxy or amino.

20 R¹⁸ represents H, halo or trifluoromethyl.

A preferred group of compounds according to the invention are compounds of formula (IIB) wherein X is O and each of R¹³ and R¹⁴ represents a methyl or a trifluoromethyl group.

25 Also preferred are compounds of formula (IIB) wherein X is O and each of R¹³ and R¹⁴ is halo, especially chloro.

30 A further sub-class of compounds according to the invention is represented by the compounds of formula (IIC), and salts and prodrugs thereof:



(IIC)

wherein R^{13} , R^{14} and R^{18} are as defined for formula (IIA) above;

Y represents H, -OH, =O or halo, preferably OH or fluoro; and the dotted line represents an optional
 15 double bond.

Preferred are compounds of formula (IIC) wherein the double bond is present.

For use in medicine, the salts of the compounds of formula (I) will be non-toxic pharmaceutically
 20 acceptable salts. Other salts may, however, be useful in the preparation of the compounds according to the invention or of their non-toxic pharmaceutically acceptable salts. Suitable pharmaceutically acceptable salts of the compounds of this invention include acid
 25 addition salts which may, for example, be formed by mixing a solution of the compound according to the invention with a solution of a pharmaceutically acceptable non-toxic acid such as hydrochloric acid, oxalic acid, fumaric acid, maleic acid, succinic acid,
 30 acetic acid, citric acid, tartaric acid, carbonic acid or phosphoric acid. Salts of amine groups may also comprise quaternary ammonium salts in which the amino nitrogen atom carries a suitable organic group such as an alkyl, alkenyl, alkynyl or aralkyl moiety. Furthermore, where

the compounds of the invention carry an acidic moiety, suitable pharmaceutically acceptable salts thereof may include metal salts such as alkali metal salts, e.g. sodium or potassium salts; and alkaline earth metal salts, e.g. calcium or magnesium salts.

5 The present invention includes within its scope prodrugs of the compounds of formula (I) above. In general, such prodrugs will be functional derivatives of the compounds of formula (I) which are readily
10 convertible in vivo into the required compound of formula (I). Conventional procedures for the selection and preparation of suitable prodrug derivatives are described, for example, in "Design of Prodrugs", ed. H. Bundgaard, Elsevier, 1985.

15 The invention also provides pharmaceutical compositions comprising one or more compounds of this invention in association with a pharmaceutically acceptable carrier. Preferably these compositions are in unit dosage form such as tablets, pills, capsules,
20 powders, granules, sterile parenteral solutions or suspensions, or suppositories, for oral, parenteral or rectal administration. For preparing solid compositions such as tablets, the principal active ingredient is mixed with a pharmaceutical carrier, e.g. conventional
25 tableting ingredients such as corn starch, lactose, sucrose, sorbitol, talc, stearic acid, magnesium stearate, dicalcium phosphate or gums, and other pharmaceutical diluents, e.g. water, to form a solid preformulation composition containing a homogeneous
30 mixture of a compound of the present invention, or a non-toxic pharmaceutically acceptable salt thereof. When referring to these preformulation compositions as homogeneous, it is meant that the active ingredient is dispersed evenly throughout the composition so that the

composition may be readily subdivided into equally effective unit dosage forms such as tablets, pills and capsules. This solid preformulation composition is then subdivided into unit dosage forms of the type described
5 above containing from 0.1 to about 500 mg of the active ingredient of the present invention. The tablets or pills of the novel composition can be coated or otherwise compounded to provide a dosage form affording the advantage of prolonged action. For example, the tablet
10 or pill can comprise an inner dosage and an outer dosage component, the latter being in the form of an envelope over the former. The two components can be separated by an enteric layer which serves to resist disintegration in the stomach and permits the inner component to pass
15 intact into the duodenum or to be delayed in release. A variety of materials can be used for such enteric layers or coatings, such materials including a number of polymeric acids and mixtures of polymeric acids with such materials as shellac, cetyl alcohol and cellulose
20 acetate.

The liquid forms in which the novel compositions of the present invention may be incorporated for administration orally or by injection include aqueous solutions, suitably flavoured syrups, aqueous or oil
25 suspensions, and flavoured emulsions with edible oils such as cottonseed oil, sesame oil, coconut oil or peanut oil, as well as elixirs and similar pharmaceutical vehicles. Suitable dispersing or suspending agents for aqueous suspensions include synthetic and natural gums
30 such as tragacanth, acacia, alginate, dextran, sodium carboxymethylcellulose, methylcellulose, polyvinylpyrrolidone or gelatin.

The present invention further provides a process for the preparation of a pharmaceutical composition

comprising a compound of formula (I), which process comprises bringing a compound of formula (I) into association with a pharmaceutically acceptable carrier or excipient.

5 The compounds of formula (I) are of value in the treatment of a wide variety of clinical conditions which are characterised by the presence of an excess of tachykinin, in particular substance P, activity. These may include disorders of the central nervous system such
10 as anxiety, depression, psychosis and schizophrenia; neurodegenerative disorders such as dementia, including senile dementia of the Alzheimer type, Alzheimer's disease and Down's syndrome; demyelinating diseases such as MS and ALS and other neuropathological disorders such
15 as peripheral neuropathy, for example, diabetic and chemotherapy-induced neuropathy, and neuralgia; respiratory diseases such as chronic obstructive airways disease, bronchopneumonia, bronchospasm and asthma; inflammatory diseases such as inflammatory bowel disease,
20 psoriasis, fibrositis, osteoarthritis and rheumatoid arthritis; allergies such as eczema and rhinitis; hypersensitivity disorders such as poison ivy; ophthalmic diseases such as conjunctivitis, vernal conjunctivitis, and the like; cutaneous diseases such as contact
25 dermatitis, atropic dermatitis, urticaria, and other eczematoid dermatitis; addiction disorders such as alcoholism; stress related somatic disorders; reflex sympathetic dystrophy such as shoulder/hand syndrome; dysthymic disorders; adverse immunological reactions such
30 as rejection of transplanted tissues and disorders related to immune enhancement or suppression such as systemic lupus erythematosus; gastrointestinal (GI) disorders and diseases of the GI tract such as disorders associated with the neuronal control of viscera such as

ulcerative colitis, Crohn's disease and incontinence;
disorders of bladder function such as bladder detrusor
hyper-reflexia; fibrosing and collagen diseases such as
scleroderma and eosinophilic fascioliasis; disorders of
5 blood flow caused by vasodilation and vasospastic
diseases such as angina, migraine and Reynaud's disease;
and pain or nociception, for example, that attributable
to or associated with any of the foregoing conditions,
especially the transmission of pain in migraine.

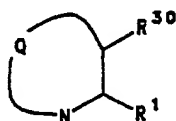
10 The compounds of formula (I) are particularly
useful in the treatment of pain or nociception and/or
inflammation and disorders associated therewith such as,
for example, neuropathy, such as diabetic or peripheral
neuropathy and chemotherapy-induced neuropathy, asthma,
15 osteoarthritis, rheumatoid arthritis and especially
migraine.

The present invention further provides a
compound of formula (I) for use in therapy. According to
a further or alternative aspect, the present invention
20 provides a compound of formula (I) for use in the
manufacture of a medicament for the treatment of
physiological disorders associated with an excess of
tachykinins, especially substance P. The present
invention also provides a method for the the treatment or
25 prevention of physiological disorders associated with an
excess of tachykinins, especially substance P, which
method comprises administration to a patient in need
thereof of a tachykinin reducing amount of a compound of
formula (I) or a composition comprising a compound of
30 formula (I).

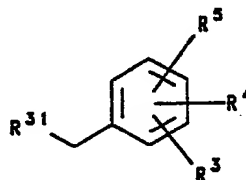
In the treatment of the conditions associated
with an excess of tachykinins, a suitable dosage level is
about 0.001 to 50 mg/kg per day, in particular about 0.01
to about 25 mg/kg, such as from about 0.05 to about 10

mg/kg per day. For example, in the treatment of conditions involving the neurotransmission of pain sensations, a suitable dosage level is about 0.001 to 25 mg/kg per day, preferably about 0.005 to 10 mg/kg per day, and especially about 0.005 to 5 mg/kg per day. The compounds may be administered on a regimen of 1 to 4 times per day, preferably once or twice per day.

The compounds according to the invention wherein X is O or S may be prepared by a process which comprises reacting a compound of formula (III) with a compound of formula (IV):



(III)



(IV)

wherein Q, R¹, R³, R⁴ and R⁵ are as defined for formula (I) above, and one of R³⁰ and R³¹ represents a leaving group and the other of R³⁰ and R³¹ represents XH, where X is as defined for formula (I); in the presence of a base.

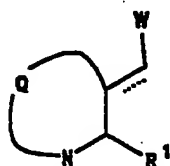
Suitably, R³¹ represents a leaving group and R³⁰ represents XH.

Suitable leaving groups include halo, e.g. chloro, bromo or iodo, or sulphonate derivatives such as tosylate or mesylate.

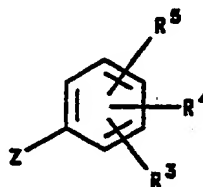
The reaction is conveniently carried out in a suitable organic solvent, such as an ether, e.g. 1,2-dimethoxyethane, at a temperature in the range of -5 to 25°C, preferably about 0°C. Favoured bases of use in the reaction include alkali metal amides and hydrides, such as potassium bis(trimethylsilyl)amide and potassium

hydride. Suitably, potassium bis(trimethylsilyl)amide is used.

The compounds according to the invention wherein X is CH or CH₂ and Y is OH may be prepared by a process which comprises reacting a compound of formula (V) with a compound of formula (VI):



(V)

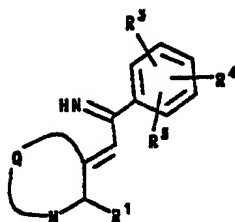


(VI)

wherein Q, R¹, R³, R⁴ and R⁵ are as defined in formula (I) and the dotted line represents an optional double bond, W represents CHO (intermediates (VB)), and Z is a metal, such as aluminium or lithium, or metal halide.

The group Z in the reaction of (V) with (VI) suitably represents a metal such as aluminium or, preferably, the residue of a Grignard agent such as MgBr. The reaction is preferably carried out in an inert organic solvent such as an ether such as diethyl ether, tetrahydrofuran or a mixture thereof.

The compounds according to the invention wherein X is CH and Y is =O may be prepared by a process which comprises hydrolysing a compound of formula (VII):



(VII)

10 wherein Q, R¹, R³, R⁴ and R⁵ are as defined in formula (I). The reaction may take place with dilute acid such as dilute mineral acid, for example, hydrochloric acid.

The compound of formula (VII) need not be isolated but may be hydrolized in situ after being
 15 prepared from the corresponding compound of formula (VA) wherein W represents CN by reaction with the corresponding compound of formula (VI) (wherein Z is preferably lithium) as described above in relation to preparing compounds of formula (I) wherein X is CH and Y
 20 is OH.

The compounds according to the invention wherein X is CH or CH₂ and Y is H may be prepared by reducing the corresponding compound of formula (I) wherein Y is OH. The reduction may be effected by
 25 standard methods known to those skilled in the art such as catalytic reduction by hydrogen in the presence of a catalyst such as platinum or palladium, preferably palladium dihydroxide. Such reduction is preferably carried out in the presence of a polar solvent such as an
 30 alcohol such as ethanol or an acid such as an inorganic acid, for example, hydrochloric acid, or a mixture thereof. Alternatively, the reduction may be carried out by, for example, lithium aluminium hydride/aluminium trichloride in the presence of a solvent such as an ether

such as diethyl ether or tetrahydrofuran or a mixture thereof, preferably at ambient temperature such as around 25°C.

The compounds according to the invention
5 wherein Y is halo may be prepared from the corresponding compounds of formula (I) wherein Y is OH using conventional techniques, for example, by reaction with a suitable halogenating agent. Examples of halogenating agents include thionyl halides, phosphorous trihalides
10 and phosphorous pentahalides.

A preferred halogenating agent for use in the reaction is diethylaminosulphurtrifluoride. The reaction is preferably conducted at low temperature, for example, at about -15 to +5°C.

15 The intermediates of formula (III) above wherein R³⁰ is SH may be prepared from the corresponding intermediates of formula (III) wherein R³⁰ represents OH by treating the latter compound with Lawesson's reagent or phosphorus pentasulphide in a suitable solvent, e.g.
20 pyridine, at ambient or elevated temperatures, suitably at reflux temperature.

The intermediates of formula (III) above wherein R³⁰ is OH may be prepared by the procedures described in J. Med. Chem., 1974, 17, 497, and J. Med.
25 Chem., 1975, 18, 587; or by methods analogous thereto.

Intermediates of formula (III) wherein R³⁰ is OH having cis stereochemistry may preferably be prepared from the corresponding ketones via a selective reduction using a suitable reducing agent such as a lithium
30 aluminium hydride or a substituted borohydride such as triethylborohydride, as described in the accompanying examples.

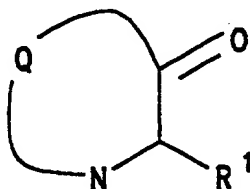
Intermediates of formula (III) wherein R³⁰ is OH having trans stereochemistry may be obtained

selectively via a procedure involving non-selective reduction of the corresponding ketone, for example using sodium in an aromatic hydrocarbon solvent, e.g. toluene, preferably in the presence of an alcohol, e.g. iso-propyl alcohol, to give a mixture of cis and trans isomers, followed by selective oxidation of the cis isomer using a ketone in the presence of a base (Oppenauer oxidation). Suitable ketones include acetone, methyl ethyl ketone, cyclohexanone and, preferably, benzophenone. Suitable bases include alkali metal hydrides, e.g. potassium hydride.

Intermediates of formula (III) wherein R^{30} is a leaving group may be prepared from compounds of formula (III) wherein R^{30} is OH, for example, by reaction with a thionyl halide, a mesyl halide or a tosyl halide.

Where they are not commercially available, the intermediates of formula (IV) above may be prepared by conventional procedures which will be readily apparent to one skilled in the art.

The compounds of formula (VA) wherein the double bond is present and W represents CN may be prepared by reaction of a compound of formula (VIII) with a Wittig reagent:



(VIII)

wherein Q and R^1 are as defined in formula (I).

Preferably, the compound of formula (VIII) is reacted with a reagent of formula $(\text{alkoxy})_2\text{PO}(\text{CH}_2\text{CN})$, such as

(EtO)₂PO(CH₂CN) or (iPrO)₂PO(CH₂CN) in the presence of an alkali or alkaline earth metal salt of an alcohol such as potassium t-butoxide in an inert organic solvent such as toluene at an elevated temperature in the range of from
5 25°C to 50°C, preferably around 50°C.

The compounds of formula (VA) wherein the double bond is absent and Y represents CN may be prepared from the corresponding compounds of formula (VA) wherein the double is present, by reduction. Suitable procedures
10 and reagents will be readily apparent to one skilled in the art, and include dissolving metal reduction, for example, using magnesium in methanol.

The intermediates of formula (VB) above wherein W is CHO may be prepared by the procedures described in
15 J. Med. Chem., 1974, 17, 497, and J. Med. Chem., 1975, 18, 587; or by methods analogous thereto. For example, from the corresponding intermediate of formula (VA) wherein W represents CN for example with a standard agent such as DIBAL-H (available from Aldrich).

20 Where they are not commercially available, the intermediates of formula (VI) above may be prepared by conventional procedures well known to those skilled in the art.

25 Where the above-described process for the preparation of the compounds according to the invention gives rise to mixtures of stereoisomers these isomers may, if desired, be separated, suitably by conventional techniques such as preparative chromatography.

30 The novel compounds may be prepared in racemic form, or individual enantiomers may be prepared either by enantiospecific synthesis or by resolution. For example, intermediate alcohols of formula (III), wherein X is O, may be resolved into their component enantiomers by standard techniques, such as the formation of

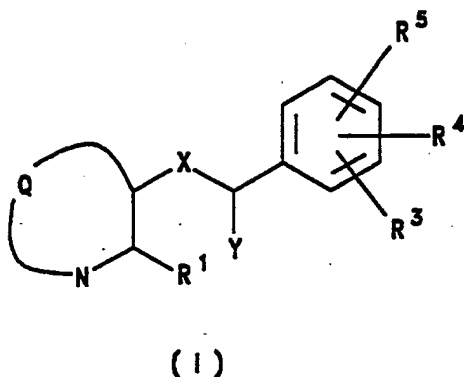
diastereomeric esters or amides, followed by chromatographic separation and removal of the chiral auxiliary. The diastereomeric alcohols can then be used to prepare optically pure compounds of formula (I).

5 During any of the above synthetic sequences it may be necessary and/or desirable to protect sensitive or reactive groups on any of the molecules concerned. This may be achieved by means of conventional protecting groups, such as those described in Protective Groups in
10 Organic Chemistry, ed. J.F.W. McOmie, Plenum Press, 1973; and T.W. Greene and P.G.M. Wutts, Protective Groups in
Organic Synthesis, John Wiley & Sons, 1991. The protecting groups may be removed at a convenient subsequent stage using methods known from the art.

15

CLAIMS:

1. A compound of formula (I), or a salt or
5 prodrug thereof:



wherein

Q is the residue of an optionally substituted azabicyclic ring system;

X represents O, S, CH₂ or CH;

20 Y represents H, OH, =O or halo;

R¹ represents phenyl optionally substituted by halo or trifluoromethyl;

R³, R⁴ and R⁵ independently represent H, C₁₋₆ alkyl, C₂₋₆ alkenyl, C₂₋₆ alkynyl, halo, cyano, nitro, 25 trifluoromethyl, trimethylsilyl, -OR^a, SCH₃, SOCH₃, SO₂CH₃, -NR^aR^b, -NR^aCOR^b, -NR^aCO₂R^b, -CO₂R^a or -CONR^aR^b; and

R^a and R^b independently represent H, C₁₋₆ alkyl, phenyl or trifluoromethyl;

30 with the proviso that when X is O or S, Y is H.

2. A compound as claimed in claim 1 for use in therapy.

Patents Act 1977
Examiner's report to the Comptroller under
Section 17 (The Search Report)

- 23 -

Application number

GB 9215527.4

Relevant Technical fields

(i) UK CI (Edition L) C2C: CQS, CUL, CWC, CZF

(ii) Int CI (Edition 5) C07D 453/02

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES : CAS-ONLINE, EDOC

Search Examiner

MISS D DAVIES

Date of Search

27 AUGUST 1993

Documents considered relevant following a search in respect of claims 1-2

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	EP 0499313 A (MERCKSHARP DOHME) quinuclidines 2-substituted by aryl methyl as tachykinin antagonists	
A, P	WO 9304040 A (MERCK SHARP DOHME) monoazacyclic compounds as tachkyninin antagonists	
A	WO 9118899 A (PFIZER INC) 3-arylmethyl amino quinuclidines as substance antagonists	

Category	Identity of document and relevant passages - 24 -	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

